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Studies on soil moisture regime in pigeon pea [*Cajanus cajan* (L.) Millsp.] Under irrigated and rainfed condition

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Abstract

A field experiment was conducted on a clayey soil at Agriculture Technical School, Aurangabad, Aurangabad district of Maharashtra during the Kharif seasons of 2019-2020 to study the soil moisture regime in pigeon pea [*Cajanus cajan* (L.) Millsp.] under irrigated and rainfed condition." Rainfall received during experimental period was 659.7 mm with 44 rainy days during Kharif 2019. The experiment was conducted in factorial randomized block design with two factors viz., varieties (V₁-BDN-711, V₂-BSMR-736, V₃-BDN-716) and five treatment stages (I irrigation at bud initiation (I₁), irrigation at pod development (I₂), irrigation at bud initiation + pod development (I₃) opening of furrow after two rows at 60 DAS (I₄), rainfed treatment (I₅.) with 15 treatments combinations. Each experimental unit was repeated three times 5.40 X 5.40 m² size in gross plot and in net plot 3.60 m x 4.60 m with 90 x 20 cm spacing. Sowing was done on 2nd July 2019. The fertilizer dose of 25:50:00NPK kg ha⁻¹ was applied after sowing. Amongst varieties, BDN-716 recorded maximum seed yield (1602 kg ha⁻¹) and net monetary returns (54835 Rs ha⁻¹) than BSMR-736(1432 kg ha⁻¹, 46121 Rs ha⁻¹) and BDN-711(1298 kg ha⁻¹, 39269 Rs ha⁻¹) respectively. Amongst irrigation stages, two irrigations at bud initiation + pod development recorded significantly maximum seed yield (1805 kg ha⁻¹) and NMR (64644 Rs ha⁻¹) followed by irrigation at pod development((1652 kg ha⁻¹, 57113 Rs ha⁻¹)), irrigation at bud initiation((1463 kg ha⁻¹, 47428 Rs ha⁻¹)), opening of furrow after two rows at 60 DAS((1232 kg ha⁻¹, 36259 Rs ha⁻¹)) and rainfed treatment((1068 kg ha⁻¹, 28265 Rs ha⁻¹)) respectively. Highest water use efficiency was observed under irrigation at pod development (27.53 kg ha⁻¹ mm⁻¹) followed by irrigation at bud initiation (24.38 kg ha⁻¹ mm⁻¹) and two irrigations at bud initiation + pod development (15.04 kg ha⁻¹ mm⁻¹).

Keywords: moisture, regime, pigeon pea, *Cajanus cajan* L.

Introduction

Pigeonpea also known as red gram, arhar and tur [*Cajanus cajan* (L.) Mill sp.] is the most important Kharif grain legume. It belongs to the family Leguminosae, sub-family papilionaceae, originated from the Africa. It has the lowest harvest index of 19% but however with a rich source of protein and amino acids like lycine, tryocene, cysteine and arginine and can be cultivated in the wide range of pH i.e 5 to 8. Limited and scanty rainfall in the rainfed areas makes pigeon pea vulnerable to experience moisture stress conditions during the later part of its growth, resulting in severe yield reduction. Sufficient soil moisture is the key to successful crop production in dry land areas. Pigeon pea crop has compensatory behaviour in respect of plant population and crop geometry to economic yield. In that case there is minimum adverse effect on yield with decrease or increase in plant population of the crop In general surface irrigation methods viz., controlled flooding, ridges and furrow are the most common methods of water delivery to pigeonpea. Efficient application of supplemental irrigation water is extremely crucial. Sustainable crop production under rainfed and irrigated condition can be achieved by conservation of excess rainwater and its efficient recycling. Hence, an experiment was conducted to quantity run off and soil loss in pigeon pea under irrigated and rainfed condition to develop relations among them.

Materials and Methods

The soil of experimental plot was medium black in colour with good drainage. The topography of experimental plot was levelled The total rainfall received during cropping season was 659.7 mm and distributed over 44 rainy days during the course of experimentation. The present experiment was laid out in Factorial Randomized Block Design.

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The experiment was conducted in factorial randomized block design with two factors viz., varieties (V₁-BDN-711, V₂-BSMR-736, V₃-BDN-716) and five treatment stages (I irrigation at bud initiation (I₁), irrigation at pod development (I₂), irrigation at bud initiation + pod development (I₃) opening of furrow after two rows at 60 DAS (I₄), rainfed treatment (I₅.) with 15 treatments combinations. Each experimental unit was repeated three times 5.40 X 5.40 m² size in gross plot and in net plot 3.60 m x 4.60 m with 90 x 20 cm spacing. Sowing was done on 2nd July 2019. The fertilizer dose of 25:50:00NPK kg ha⁻¹ was applied after sowing. Periodical soil samples were collected from 15cm and 30cm soil depth increments from at 30 day interval from 30, 60, 90, 120, 150 DAS to harvest, respectively. The amount of soil moisture loss was estimated by gravimetric method as given by Black (1965). The runoff collected after rainfall was stirred, mixed and measured. The soil loss was measured from the sample collected after evaporating the sample in the oven. The rainfall was also measured. Thus, the soil loss and runoff loss estimation were calculated. The benefit: cost ratio of each treatment was calculated by dividing the gross monetary returns by the mean cost of cultivation.

Result and Discussion

Amongst irrigation stages, two irrigations at bud initiation + pod development showed maximum plant height, number of functional leaves, mean number of branches, mean total dry matter plant⁻¹ followed by irrigation at pod development, irrigation at bud initiation, Opening of furrow after two rows at 60 DAS and rainfed treatment, was observed at 120, 150 DAS and at harvest, respectively. Two irrigations at bud initiation + pod development produced significantly maximum number of pods plant⁻¹, weight of pods plant⁻¹, seed yield plant⁻¹ and seed index than rest of irrigation stages. Superior performance of two irrigations at bud initiation + pod development over irrigation at pod development as well as irrigation at bud initiation, Opening of furrow after two rows at 60 DAS and rainfed treatment. Amongst irrigation stages, two irrigations at bud initiation + pod development noted significantly maximum seed yield (1805 kg ha⁻¹), straw yield (3854 kg ha⁻¹), biological yield (5659 kg ha⁻¹) than rest of the irrigation stages and was followed by irrigation at pod development (1652, 3637, 5290 kg ha⁻¹), irrigation at bud

initiation (1463, 3262, 4726 kg ha⁻¹), opening of furrow after two rows at 60 DAS (1232, 2846, 4079 kg ha⁻¹) and rainfed (1068, 2510, 3579 kg ha⁻¹) treatment, respectively. Two irrigations at bud initiation + pod development recorded maximum harvest index and it was followed by irrigation at pod development, irrigation at bud initiation opening of furrow after two rows at 60 DAS and rainfed treatment, respectively. Soil moisture was not significantly influenced due to varieties under study. In case of irrigation stages at depth of 15cm two irrigations at bud initiation + pod development recorded significantly more soil moisture at 150 DAS (28.33%) and at harvest (16.69%), however, it was comparable with irrigation at pod development. And at depth of 30cm two irrigations at bud initiation + pod development recorded significantly more soil moisture at 150 DAS (31.24%) and at harvest (17.18%), however, it was comparable with irrigation at pod development. BDN-716 recorded maximum IWUE (26.7 kg ha⁻¹ mm⁻¹) compared to BSMR- 736 (23.86 kg ha⁻¹ mm⁻¹) and BDN-711 (21.63 kg ha⁻¹ mm⁻¹) variety. Amongst irrigation stages irrigation at pod development recorded maximum IWUE (27.53 kg ha⁻¹ mm⁻¹) followed by irrigation at bud initiation (24.38 kg ha⁻¹ mm⁻¹) and two irrigations at bud initiation + pod development (15.04 kg ha⁻¹ mm⁻¹), respectively. Highest water use efficiency was observed under irrigation at pod development (27.53 kg ha⁻¹ mm⁻¹) followed by irrigation at bud initiation (24.38 kg ha⁻¹ mm⁻¹) and two irrigations at bud initiation + pod development (15.04 kg ha⁻¹ mm⁻¹), respectively, under limited water source and to have better water use efficiency irrigation at pod development is better than two irrigations at bud initiation + pod development. Amongst irrigation stages, two irrigations at bud initiation + pod development recorded maximum seed yield (1805 kg ha⁻¹) and net monetary returns (Rs 64644 ha⁻¹) followed by irrigation at pod development (1652 kg ha⁻¹, 57113 Rs ha⁻¹), bud initiation (1463 kg ha⁻¹, 47428 Rs ha⁻¹), opening of furrow after two rows at 60 DAS (1232 kg ha⁻¹, 36259 Rs ha⁻¹) and rainfed treatment (1068 kg ha⁻¹, 28265 Rs ha⁻¹), respectively. Amongst varieties, BDN-716 recorded maximum seed yield (1602 kg ha⁻¹) and net monetary returns (54835 Rs ha⁻¹) than BSMR-736 (1432 kg ha⁻¹ and 46121 kg ha⁻¹) and BDN-711 (1298 kg ha⁻¹ and 39269 Rs ha⁻¹). Above conclusions were drawn from one season study and need to be verified further for concrete conclusion.

Table 1: Soil moisture studies (%) as influenced by different variety and irrigation stages at 30cm

Treatment	Days after sowing					At harvest
	30	60	90	120	150	
I) Varieties						
BDN-711	24.52	31.02	24.53	22.56	22.93	16.05
BSMR-736	24.61	31.04	24.46	22.42	23.22	16.14
BDN-716	24.58	31.04	24.57	22.62	23.2	16.33
SE ±	0.16	0.15	0.12	0.43	0.31	0.09
CD at 5%	NS	NS	NS	NS	NS	NS
II) Irrigations stages						
Rainfed (Control)	24.56	30.94	24.36	22.33	16.64	14.56
Opening of furrow after two rows at 60 DAS	24.74	31.12	24.81	22.56	18.31	15.90
At Bud initiation	24.53	31.09	24.42	22.87	18.36	16.21
At Pod development	24.55	30.94	24.44	21.97	31.07	17.02
At Bud initiation and Pod development	24.45	31.10	24.55	22.96	31.24	17.18
SE ±	0.21	0.19	0.15	0.39	0.40	0.12
CD at 5%	NS	NS	NS	NS	1.15	0.34
Interaction (VXI)						
SE ±	0.36	0.33	0.27	0.67	0.69	0.20
CD at 5%	NS	NS	NS	NS	NS	NS
General Mean	24.57	31.04	24.52	22.53	23.12	16.17

Table 2: Irrigation water use efficiency studies as influenced by different variety and irrigation stages.

Treatments	Rainfall (mm)	water applied (mm)	seed yield (kg ha ⁻¹)	IWUE (kg ha ⁻¹ mm ⁻¹)
I) Varieties				
BDN-711	659.7	60	1298	21.63
BSMR-736	659.7	60	1432	23.86
BDN-716	659.7	60	1602	26.7
II) Irrigations stages				
Rainfed (Control)	659.7	-	1068	-
Opening of furrow after two rows at 60 DAS	659.7	-	1232	-
Bud initiation	659.7	60	1463	24.38
Pod development	659.7	60	1652	27.53
Bud initiation and Pod development	659.7	120	1805	15.04
Average	659.7		1444	24.06

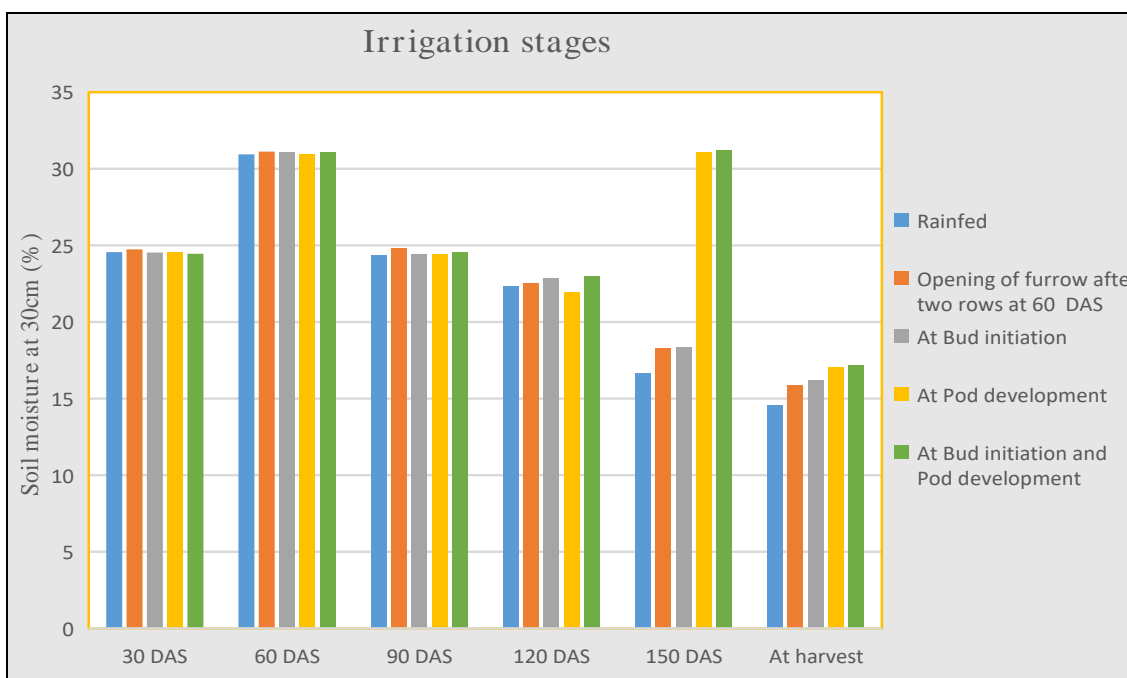
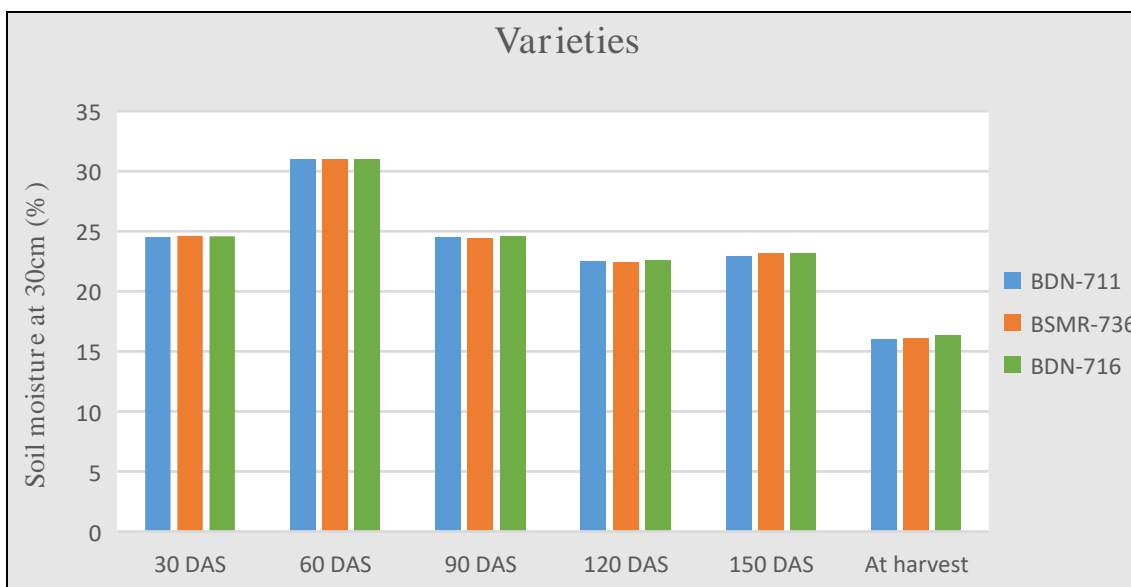


Fig 1: Soil moisture studies as influenced by different variety and irrigation stages at 30cm

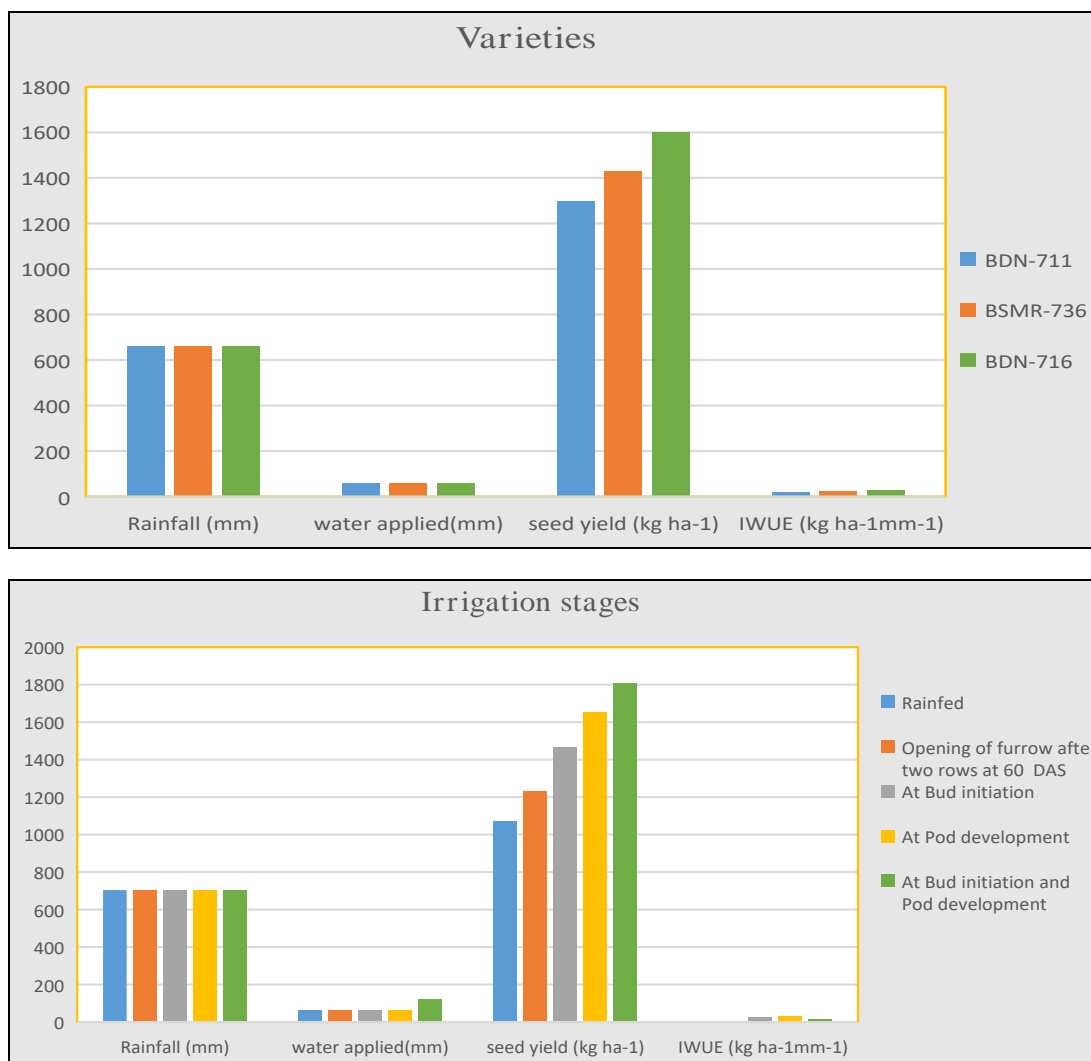


Fig 2: Water use efficiency as influenced by different variety and irrigation stages at 30cm

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